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HAMAKUA AREA AGRICULTURAL WATER STUDY

ISLAND OF HAWAII, HAWAII

AGRICULTURAL WATER SYSTEM PROPOSALS

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Honolulu, Hawaii

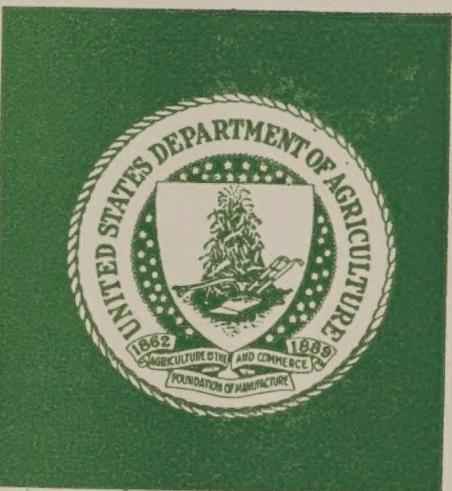
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HAMAKUA AREA AGRICULTURAL WATER STUDY

FOR INFORMATION - CONTACT

STUDY SPONSORS

State of Hawaii, Department of Land and Natural Resources,
Division of Water and Land Development, Honolulu, Hawaii

Robert T. Chuck, Manager-Chief Engineer - Phone 548-7539

Mauna Kea Soil and Water Conservation District, Waimea, Hawaii

Earl Spence, Chairman - Phone 885-7311

U.S. DEPARTMENT OF AGRICULTURE

Soil Conservation Service, Honolulu, Hawaii

Jack P. Kanalz, State Conservationist - Phone 546-3165

Kenneth Kaneshiro, Planning Staff Leader - Phone 546-3165

Jack Sprague, District Conservationist, Waimea, Hawaii - Phone 885-4107

Forest Service

Robert Clayton, Honolulu, Hawaii - Phone 546-5669

Robert Erwin, San Francisco, California

Economics and Statistics Service

Norman Landgren, Lincoln, Nebraska

Daniel Piper, San Francisco, California

PURPOSE OF THE MEETING

This meeting is being held to present and discuss agricultural water systems that can be used to formulate a plan to resolve the agricultural water and other resource problems of the area. A major problem that has been identified is the need for improving the agricultural water distribution system.

The meeting and this booklet are intended to provide information so you can evaluate the various systems and provide input in formulating the preferred plan for the area. Your ideas are important. Please express your views at the meeting.

If you need more information or want to express your view directly to the sponsors or planners, call one of the numbers listed above.

HISTORY OF THE STUDY

In September 1977, the study sponsors requested the Soil Conservation Service to investigate the agricultural water problems in the Hamakua area. Jack P. Kanalz, State Conservationist, Soil Conservation Service, in consultation with other agencies, concluded that a study of the area could best be made with the cooperation of other USDA agencies - the Forest Service and the Economics and Statistics Service. After preparation of a Proposal to Study and a Plan of Work, the study was authorized to proceed in May 1979.

Since its authorization, the following reports have been published:

Economic Base
Water Resources
Environmental Impact Assessment

Soon to be published are the following reports:

Water Use
Land Resources
Forest Resources

The study is being conducted under the authority of Section 6 of Public Law 83-566. All activities carried out under this authorization are through the leadership of the Soil Conservation Service.

This authority is not an implementation authority. In other words, it does not provide for cost-sharing funds to install the preferred plan.

The results of this cooperative study will be contained in a main report. This report will contain information on the problems and concerns studied. It will also have solutions to the problems and how the solutions could be implemented.

DESCRIPTION

The study area is located in the Hamakua District of the island of Hawaii. The study area totals about 200,000 acres.

The major economic activity in the area is the sugar industry followed by the livestock industry and truck crop operations. Agricultural uses cover about 125,000 acres. The remaining acreage is in forest reserve, urban, and miscellaneous land.

STUDY CONCERNS

The public concerns in the study area focused on problems relating to agricultural water, land treatment, and making better use of agricultural land.

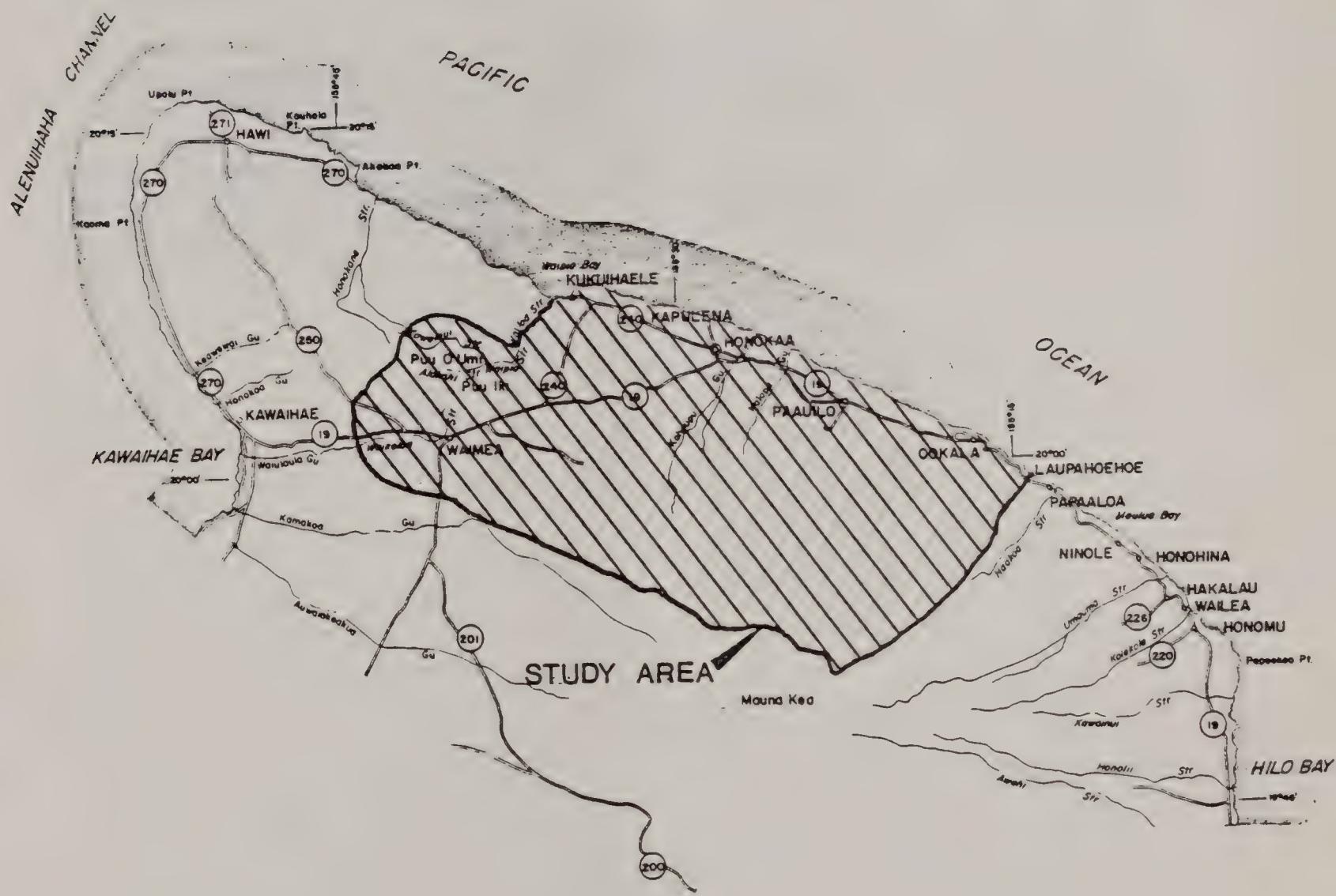
<u>Concern</u>	<u>Need</u>
Insufficient Irrigation Water Supply	More irrigation water for farmlots in Ahualoa, Lalamilo, Puukapu, Paauilo Mauka, and sugarcane fields from Paauilo to Waipio.
Insufficient Stockwater in the Upper Areas	More stockwater for Paauilo Mauka, Honokaa, Paauhau, and area between Keanakolu and Hanaipoi.
Improved Agricultural Water Distribution System	Reassess the present water distribution system and suggest changes.
Land Treatment and Irrigation Water Management	Installing land treatment practices on irrigated agricultural land and promote further use of irrigation water management on these lands.
Better Use for Agricultural Land	Investigate opportunities to make better use of agricultural land.

These concerns were selected because they are the ones that reflect the most pressing agricultural water problems and are those that affect most of the people in the area.

LOCATION MAP



Hawaii
Study Area



5 0 5 10 15 MILES

SCALE 1:570,000

HAMAKUA AREA
AGRICULTURAL WATER STUDY
Hawaii County, Hawaii

THE AGRICULTURAL WATER SYSTEMS

The agricultural water systems described in the following pages are divided into three agricultural water use areas. These are: sugarcane, truck crops, and stockwater.

In order to adequately analyze each of these areas, each area was divided into levels of usage by selecting the most probable first level and then adding increments of usage. Costs and benefits were determined for each level. By studying the needs of each level, the maximum benefits to be incurred can be determined.

Components of these systems were also studied to determine the most economical method to do the job. For example, reservoirs of different sizes and locations were designed and costs estimated to determine where a given volume of water could be stored for the least cost. The collection system was also studied to find the least cost component. Least cost components such as a collection system, reservoir, and distribution system for the capacities needed were formulated into a system to supply the specific level of usage.

A. SUPPLEMENTAL WATER FOR SUGARCANE

General Description

Supplemental irrigation water to Davies Hamakua Sugar Company's Lower Hamakua Ditch that irrigates their lands under their conversion plan until 1987.

Collection System

The upper reach of the Upper Hamakua Ditch will be rehabilitated. Flow from Kawainui, Kawaiki and Alakahi streams will be diverted by an open concrete ditch to the reservoir site. Diversion of water from these streams will affect the operation of the existing Lalamilo Irrigation System.

Reservoir Storage Requirement

A 100-MG reservoir will be needed in the Kohala Mountains to provide needed storage.

Distribution System

A conduit will carry the stored water down to the Lower Hamakua Ditch to supplement the existing and planned irrigated sugarcane fields of Davies Hamakua Sugar Company. Peak irrigation demands were used to size the conduit.

12 Peak MGD 721 Annual MG

Irrigation Requirements

Irrigation needs are based on an 80-percent chance effective rainfall and assuming drip irrigation with a field application efficiency of 80 percent.

52.5 Peak MGD 6903 Annual MG

Acres Irrigated

	<u>Present</u>	<u>Future</u>	<u>Total</u>
Drip.....	<u>1854</u>	<u>4475</u>	<u>6329</u>
Overhead.....	<u>5041</u>	<u>3411</u>	<u>1630</u>
Total	<u>6895</u>	<u>1064</u>	<u>7959</u>

Installation Cost

	<u>Capital</u>	<u>O&M</u>	<u>Total Annual</u>
Collection System.....	\$ <u>4,873,300</u>	\$ <u>7,600</u>	\$ <u>377,500</u>
Reservoir.....	<u>5,680,000</u>	<u>6,000</u>	<u>437,200</u>
Distribution System.....	<u>9,727,100</u>	<u>34,100</u>	<u>772,500</u>
Total	<u>\$20,280,400</u>	<u>\$47,700</u>	<u>\$1,587,200</u>

Benefits

Annual Benefits.....	\$ <u>716,300</u>
Benefit-Cost Ratio.....	<u>.45</u>



B. PLANNED EXPANSION FOR SUGARCANE

General Description

Supplemental irrigation water to supply the Lower Hamakua Ditch as in System A. In addition, this system will supply water to areas, not presently or planned to be irrigated, that require 20 inches or more of irrigation water a year.

Collection System

The upper reach of the Upper Hamakua Ditch will be rehabilitated from Kawainui to Alakahi streams. Flow from Kawainui, Kawaiki, Alakahi, Kohakohau and Waikoloa streams will be diverted by a concrete channel and pipeline to the reservoir sites. Diversion structures designed to bypass low flows and limit high flows will be installed at these streams. Also, provisions will be made to bypass the flow rate presently being diverted from Kohakohau and Waikoloa streams by the County Board of Water Supply. Diversion of water from the Kawainui, Kawaiki, and Alakahi streams will affect the operation of the existing Lalamilo Irrigation System.

Reservoir Storage Requirement

Two reservoirs totaling 2,000 MG storage capacity will be required. A 500-MG reservoir in the Kohala Mountains will supplement a larger 1,500-MG reservoir at the existing Puukapu flood retention structure.

Distribution System

Various sizes of conduits will carry stored water along the Hamakua Coast to irrigate the sugarcane fields. Peak irrigation demands were used to size the conduits.

78 Peak MGD 4,622 Annual MG

Irrigation Requirements

Irrigation needs are based on an 80-percent chance effective rainfall and assuming drip irrigation with a field application efficiency of 80 percent.

118 Peak MGD 10,805 Annual MG

Acres Irrigated

	Present	Future	Total
Drip.....	1,854	10,582	12,436
Overhead.....	5,041	-3,411	1,630
Total	6,895	7,171	14,066

Installation Cost

	Capital	O&M	Total Annual
Collection System.....	\$ 4,873,300	\$ 25,300	\$ 395,200
Reservoir.....	62,198,500	11,500	4,733,000
Distribution System.....	54,227,500	373,100	4,489,400
Total	\$121,299,300	\$409,900	\$9,617,700

Benefits

Benefits.....	\$ 796,300
Benefit-Cost Ratio.....	.08



D. EXISTING TRUCK CROPS

General Description

Irrigation water supplying the existing Lalamilo, Hawaiian Homes and Puukapu farmlots in addition to the planned expansion of Lalamilo.

Collection System

The Upper Hamakua Ditch will be rehabilitated. Water from the Kawainui, Kawaiki, Alakahia, Koiawe, and Waima Streams will be diverted into the Upper Hamakua Ditch to the reservoir sites. The diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

The existing 60-MG reservoir and the improvement of the existing Puu Pulehu Reservoir to 140 MG will be needed for storage. Water in the 60-MG reservoir will flow through a conduit to the Puu Pulehu Reservoir.

Distribution System

A conduit will be connected to the existing 24-inch conduit servicing the Lalamilo, Hawaiian Homes and Puukapu farmlots. A pumping station will be located at the Puu Pulehu Reservoir.

Lalamilo flow.....	<u>7.0</u>	MGD pressure	<u>110</u>	psi
Hawaiian Homes and Puukapu flow	<u>3.4</u>	MGD pressure	<u>70</u>	psi (pump)

25 psi (gravity)

Irrigation Requirements

Irrigation needs were based on sprinkler-irrigated truck crops. The peak irrigation demand was used to size the conduits.

Lalamilo.....	<u>3.5</u>	Peak MGD	<u>874</u>	Annual MG
Hawaiian Homes and Puukapu.....	<u>1.8</u>	Peak MGD	<u>324</u>	Annual MG

Acres Irrigated

	Present	Future	Total
Lalamilo.....	<u>250</u>	<u>163</u>	<u>413</u>
Hawaiian Homes and Puukapu.....	<u>255</u>	<u>0</u>	<u>255</u>
Total	<u>505</u>	<u>163</u>	<u>668</u>

Installation Cost

	Capital	O&M	Total Annual
Collection System.....	\$ <u>8,909,400</u>	\$ <u>73,700</u>	\$ <u>750,000</u>
Reservoir.....	<u>1,758,000</u>	<u>16,100</u>	<u>149,600</u>
Distribution System.....	<u>1,679,000</u>	<u>39,360</u>	<u>166,800</u>
Total	\$ <u>12,346,400</u>	\$ <u>129,160</u>	\$ <u>1,066,400</u>

Benefits

Benefits.....	\$ <u>713,700</u>
Benefit-Cost Ratio.....	<u>.67</u>



E. PLANNED EXPANSION FOR TRUCK CROPS - KOHALA

General Description

Irrigation water to supply the existing and the presently planned expansion of Lalamilo, Hawaiian Homes and Puukapu farmlots.

Collection System

The upper reach of the Upper Hamakua Ditch and the portion between Koiawe Stream and the 60-MG reservoir will be rehabilitated. Water from the Kawainui, Kawaiki and Alakahia streams will be diverted by an open concrete ditch to the new reservoir site; while Koiawe and Waima streams will be diverted to the 60-MG reservoir. The diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

The existing 60-MG reservoir and an additional 300 MG reservoir located in the Kohala Mountains will be needed for storage.

Distribution System

A conduit from the reservoir will be connected to the existing 24-inch conduit serving the Lalamilo, Hawaiian Homes and Puukapu farmlots.

Lalamilo flow.....	<u>9.2</u>	MGD	pressure	<u>125</u>	psi
Hawaiian Homes and Puukapu flow	<u>9.2</u>	MGD	pressure	<u>70</u>	psi

Irrigation Requirements

Irrigation needs were based on sprinkler-irrigated truck crops. The peak irrigation demand was used to size the conduits.

Lalamilo.....	<u>4.6</u>	Peak MGD	<u>1,147</u>	Annual MG
Hawaiian Homes and Puukapu.....	<u>4.6</u>	Peak MGD	<u>857</u>	Annual MG

Acres Irrigated

	<u>Present</u>	<u>Future</u>	<u>Total</u>
Lalamilo.....	<u>250</u>	<u>288</u>	<u>538</u>
Hawaiian Homes and Puukapu.....	<u>255</u>	<u>404</u>	<u>659</u>
Total	<u>505</u>	<u>692</u>	<u>1,197</u>

Installation Cost

	<u>Capital</u>	<u>O&M</u>	<u>Total Annual</u>
Collection System.....	\$ <u>7,143,000</u>	\$ <u>29,000</u>	\$ <u>571,200</u>
Reservoir.....	<u>12,200,000</u>	<u>6,700</u>	<u>932,800</u>
Distribution System.....	<u>2,822,800</u>	<u>16,800</u>	<u>232,700</u>
Total	\$ <u>22,165,800</u>	\$ <u>52,500</u>	\$ <u>1,736,700</u>

Benefits

Benefits.....	\$ <u>1,276,900</u>
Benefit-Cost Ratio.....	<u>.74</u>



F. PLANNED EXPANSION FOR TRUCK CROPS - PUU PULEHU

General Description

Irrigation water to supply the existing and the presently planned expansion of Lalamilo, Hawaiian Homes and Puukapu farmlots.

Collection System

The Upper Hamakua Ditch will be rehabilitated. Water from the Kawainui, Kawaiki, Alakahi, Koiawe, and Waima Streams will be diverted into the Upper Hamakua Ditch to the reservoir sites. The diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

The existing 60-MG reservoir and the expansion of the existing Puu Pulehu Reservoir to 300 MG will be needed for storage. Water in the 60-MG reservoir will flow through an open concrete ditch to the Puu Pulehu Reservoir.

Distribution System

A conduit will be connected to the existing 24-inch conduit servicing the Lalamilo, Hawaiian Homes and Puukapu farmlots. A pumping station will be located at the Puu Pulehu Reservoir.

Lalamilo flow.....	9.2	MGD	pressure	110	psi
Hawaiian Homes and Puukapu flow	9.2	MGD	pressure	60	psi (pump)
				20	psi (gravity)

Irrigation Requirements

Irrigation needs were based on sprinkler-irrigated truck crops. The peak irrigation demand was used to size the conduits.

Lalamilo.....	4.6	Peak MGD	1,147	Annual MG
Hawaiian Homes and Puukapu.....	4.6	Peak MGD	857	Annual MG

Acres Irrigated

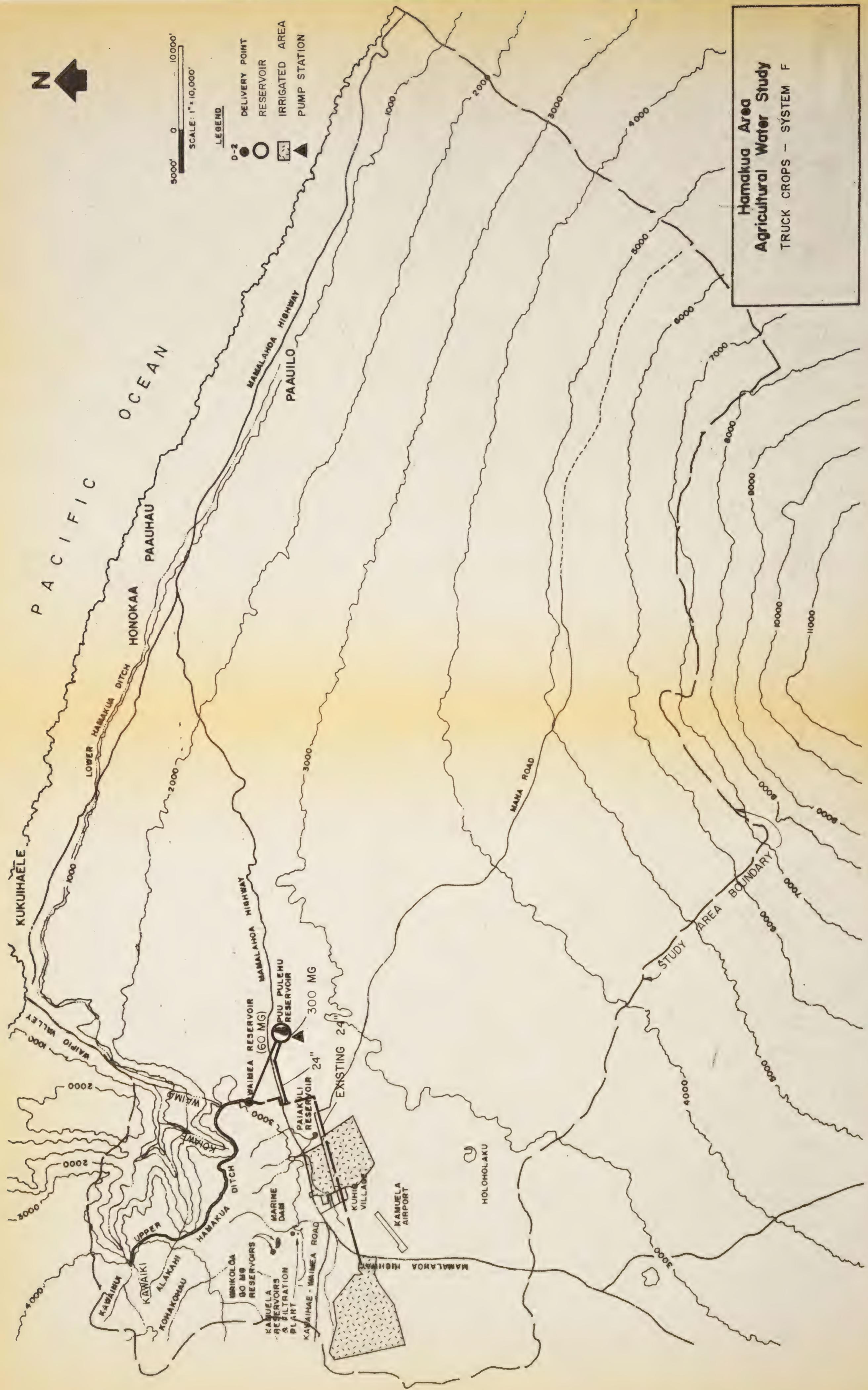
	Present	Future	Total
Lalamilo.....	250	288	538
Hawaiian Homes and Puukapu.....	255	404	659
Total	505	692	1,197

Installation Cost

	Capital	O&M	Total Annual
Collection System.....	\$ 8,909,400	\$ 73,700	\$ 750,000
Reservoir.....	9,466,800	6,700	725,300
Distribution System.....	2,195,000	91,600	260,800
Total	20,571,200	\$172,000	\$1,736,100

Benefits

Benefits.....	\$ 1,276,900
Benefit-Cost Ratio.....	.74



G. FUTURE EXPANSION FOR TRUCK CROPS - KOHALA

General Description

Irrigation water to supply the existing, presently planned and future expansion of Lalamilo, Hawaiian Homes and Puukapu farmlots.

Collection System

The upper reach of the Upper Hamakua Ditch and the portion between Koiawe Stream and the existing 60-MG reservoir will be rehabilitated. Water from the Kawainui, Kawaiki and Alakahia streams will be diverted by an open concrete ditch to the new reservoir site; while water from Koiawe and Waima streams will be diverted to the 60-MG reservoir. The diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

The existing 60-MG reservoir and an additional 460-MG reservoir located in the Kohala Mountains will be needed for storage.

Distribution System

A conduit from the reservoir will be connected to the existing 24-inch conduit serving the Lalamilo, Hawaiian Homes and Puukapu farmlots.

Lalamilo flow.....	<u>14.2</u>	MGD	pressure	<u>125</u>	psi
Hawaiian Homes and Puukapu flow	<u>12.8</u>	MGD	pressure	<u>40</u>	psi

Irrigation Requirements

Irrigation needs were based on sprinkler-irrigated truck crops. The peak irrigation demand was used to size the conduits.

Lalamilo.....	<u>7.1</u>	Peak MGD	<u>1,776</u>	Annual MG
Hawaiian Homes and Puukapu.....	<u>6.4</u>	Peak MGD	<u>1,196</u>	Annual MG

Acres Irrigated

	Present	Future	Total
Lalamilo.....	<u>250</u>	<u>576</u>	<u>826</u>
Hawaiian Homes and Puukapu.....	<u>255</u>	<u>655</u>	<u>910</u>
Total	<u>505</u>	<u>1,231</u>	<u>1,736</u>

Installation Cost

	Capital	O&M	Total Annual
Collection System.....	\$ <u>7,143,000</u>	\$ <u>29,000</u>	\$ <u>571,200</u>
Reservoir.....	<u>17,200,000</u>	<u>7,500</u>	<u>1,313,200</u>
Distribution System.....	<u>3,178,600</u>	<u>18,100</u>	<u>259,400</u>
Total	<u>\$27,521,600</u>	<u>\$54,600</u>	<u>2,143,800</u>

Benefits

Benefits.....	\$ <u>4,158,900</u>
Benefit-Cost Ratio.....	<u>1.94</u>



H. FUTURE EXPANSION FOR TRUCK CROPS - PUU PULEHU

General Description

Irrigation water to supply the existing, presently planned and future expansion of Lalamilo, Hawaiian Homes and Puukapu farmlots.

Collection System

The Upper Hamakua Ditch will be rehabilitated. Water from the Kawainui, Kawaiki, Alakahi, Koiawe, and Waima Streams will be diverted into the Upper Hamakua Ditch to the reservoir sites. The diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

The existing 60-MG reservoir and the expansion of the existing Puu Pulehu Reservoir to 460 MG will be needed for storage. Water in the 60-MG reservoir will flow through an open concrete ditch to the Puu Pulehu Reservoir.

Distribution System

A conduit will be connected to the existing 24-inch conduit to service the Lalamilo farmlots. Another conduit will be installed to service the Hawaiian Homes and Puukapu farmlots. A pumping station will be located at the Puu Pulehu Reservoir.

Lalamilo flow.....	<u>14.2</u>	MGD	pressure	<u>100</u>	psi
Hawaiian Homes and Puukapu flow	<u>12.8</u>	MGD	pressure	<u>60</u>	psi (pump)
				<u>20</u>	psi (gravity)

Irrigation Requirements

Irrigation needs were based on sprinkler-irrigated truck crops. The peak irrigation demand was used to size the conduits.

Lalamilo.....	<u>7.1</u>	Peak MGD	<u>1,776</u>	Annual MG
Hawaiian Homes and Puukapu.....	<u>6.4</u>	Peak MGD	<u>1,196</u>	Annual MG

Acres Irrigated

	<u>Present</u>	<u>Future</u>	<u>Total</u>
Lalamilo.....	<u>250</u>	<u>576</u>	<u>826</u>
Hawaiian Homes and Puukapu.....	<u>255</u>	<u>655</u>	<u>910</u>
Total	<u>505</u>	<u>1,231</u>	<u>1,736</u>

Installation Cost

	<u>Capital</u>	<u>O&M</u>	<u>Total Annual</u>
Collection System.....	\$ <u>8,909,600</u>	\$ <u>74,400</u>	\$ <u>750,700</u>
Reservoir.....	\$ <u>17,243,100</u>	\$ <u>7,000</u>	\$ <u>1,315,900</u>
Distribution System.....	\$ <u>4,455,000</u>	\$ <u>119,100</u>	\$ <u>459,900</u>
Total	\$ <u>30,607,700</u>	\$ <u>200,500</u>	\$ <u>2,526,500</u>

Benefits

Benefits.....	\$ <u>4,158,900</u>
Benefit-Cost Ratio.....	<u>1.65</u>



I. PLANNED EXPANSION FOR STOCKWATER SYSTEM

General Description

Stockwater to supply the ranches along the Hamakua coast and in the Kamuela area presently serviced by the Board of Water Supply.

Collection System

The upper reach of the Upper Hamakua Ditch from Kawainui Stream to Alakahi Stream will be rehabilitated. Water from the Kawainui, Kawaiki and Alakahi Streams will be diverted by pipeline to the distribution system. Diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

No water storage will be required.

Distribution System

Various size conduits will convey water from the collection system to ranches along the Hamakua coast and in the Kamuela area, up to approximately 2,900 feet elevation.

Stockwater Requirements

Stockwater requirements are based on a 90-percent chance annual rainfall. The peak stockwater requirements were used to size the conduits.

.09 Peak MGD 25.6 Annual MG

Area Serviced

	<u>Total</u>
Board of Water Supply.....	14,790
Parker Ranch.....	0
Hawaiian Home Lands	0
Total	<u>14,790</u>

Installation Cost

	<u>Capital</u>	<u>O&M</u>	<u>Total Annual</u>
Collection System.....	\$2,203,200	\$16,400	\$183,600
Reservoir.....	0	0	0
Distribution System.....	607,100	4,000	50,100
Total	<u>\$2,810,300</u>	<u>\$20,400</u>	<u>\$233,700</u>

Benefits

Benefits.....	<u>\$ 123,900</u>
Benefit-Cost Ratio.....	<u>.53</u>



J. PLANNED EXPANSION FOR STOCKWATER SYSTEM

General Description

Stockwater to supply ranches along the Hamakua Coast and in the Kamuela area presently serviced by the Board of Water Supply and Parker Ranch system.

Collection System

The upper reach of the Upper Hamakua Ditch from Kawainui Stream to Alakahi Stream will be rehabilitated. Water from the Kawainui, Kawaiki and Alakahi Streams will be diverted by pipeline to the distribution system. Diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

No water storage will be required.

Distribution System

Various size conduits will convey water from the collection system to ranches along the Hamakua coast and in the Kamuela area, up to approximately 2,900 feet elevation.

Stockwater Requirements

Stockwater requirements are based on a 90-percent chance annual rainfall. The peak stockwater requirements were used to size the conduits.

.13 Peak MGD 42.1 Annual MG

Area Serviced

	<u>Total</u>
Board of Water Supply.....	14,790
Parker Ranch.....	14,788
Hawaiian Home Lands.....	0
Total	<u>29,578</u>

Installation Cost

	<u>Capital</u>	<u>O&M</u>	<u>Total Annual</u>
Collection System.....	<u>\$2,411,200</u>	<u>\$16,500</u>	<u>\$199,500</u>
Reservoir.....	<u>0</u>	<u>0</u>	<u>0</u>
Distribution System.....	<u>668,400</u>	<u>5,000</u>	<u>55,800</u>
Total	<u>\$3,079,600</u>	<u>\$21,500</u>	<u>\$255,300</u>

Benefits

Benefits.....	<u>\$ 121,900</u>
Benefit-Cost Ratio.....	<u>.48</u>



K. PLANNED EXPANSION FOR STOCKWATER SYSTEM

General Description

Stockwater to the ranches along Mana Road presently being serviced by the Board of Water Supply up to elevation 7,400 feet.

Collection System

The upper reach of the Upper Hamakua Ditch from Kawainui Stream to Alakahi Stream will be rehabilitated. Water from the Kawainui, Kawaiki and Alakahi Streams will be diverted by pipeline to the distribution system. Diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

No water storage will be required.

Distribution System

Various size conduits will carry water from the collection system to the ranches along Mana Road. A series of six booster pumps and seven steel storage tanks will also be installed to deliver stockwater to the higher elevations.

Stockwater Requirements

Stockwater requirements are based on a 90-percent chance annual rainfall. The peak stockwater requirements were used to size the conduits.

.21 Peak MGD 62.7 Annual MG

Area Serviced

	<u>Total</u>
Board of Water Supply.....	43,900
Parker Ranch.....	0
Hawaiian Home Lands.....	0
Total	<u>43,900</u>

Installation Cost

	<u>Capital</u>	<u>O&M</u>	<u>Total Annual</u>
Collection System.....	\$ 2,671,200	\$ 77,300	\$ 280,100
Reservoir.....	0	0	0
Distribution System.....	15,214,400	265,200	1,420,100
Total	<u>\$17,885,600</u>	<u>\$342,500</u>	<u>\$1,700,200</u>

Benefits

Benefits.....	\$ 370,100
Benefit-Cost Ratio.....	<u>.22</u>



L. PLANNED EXPANSION FOR STOCKWATER SYSTEM

General Description

Stockwater to the ranches along Mana Road presently being serviced by the Board of Water Supply and Hawaiian Home Lands systems to elevation 7,400 feet.

Collection System

The upper reach of the Upper Hamakua Ditch from Kawainui Stream to Alakahi Stream will be rehabilitated. Water from the Kawainui, Kawaiki and Alakahi Streams will be diverted by pipeline to the distribution system. Diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

No water storage will be required.

Distribution System

Various size conduits will carry water from the collection system to the ranches along Mana Road. A series of seven booster pumps and eight steel storage tanks will also be installed to deliver stockwater to the higher elevations.

Stockwater Requirements

Stockwater requirements are based on a 90-percent chance annual rainfall. The peak stockwater requirements were used to size the conduits.

.26 Peak MGD 76.1 Annual MG

Area Serviced

	Total
Board of Water Supply.....	43,900
Parker Ranch.....	0
Hawaiian Home Lands.....	9,790
Total	53,690

Installation Cost

	Capital	O&M	Total Annual
Collection System.....	\$ 2,671,200	\$ 77,800	\$ 280,600
Reservoir.....	0	0	0
Distribution System.....	15,551,600	284,600	1,465,100
Total	\$18,222,800	\$362,400	\$1,745,700

Benefits

Benefits.....	\$ 452,600
Benefit-Cost Ratio.....	.26





M. PLANNED EXPANSION FOR STOCKWATER SYSTEM

General Description

Stockwater to the ranches along Mana Road presently being serviced by the Board of Water Supply, Hawaiian Home Lands and Parker Ranch systems to elevation 7,400 feet.

Collection System

The upper reach of the Upper Hamakua Ditch from Kawainui Stream to Alakahi Stream will be rehabilitated. Water from the Kawainui, Kawaiki and Alakahi Streams will be diverted by pipeline to the distribution system. Diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

No water storage will be required.

Distribution System

Various size conduits will carry water from the collection system to the ranches along Mana Road. A series of six pump stations and seven steel storage tanks will also be installed to deliver stockwater to the higher elevations.

Stockwater Requirements

Stockwater requirements are based on a 90-percent chance annual rainfall. The peak stockwater requirements were used to size the conduits.

.38 Peak MGD 117.6 Annual MG

Area Serviced

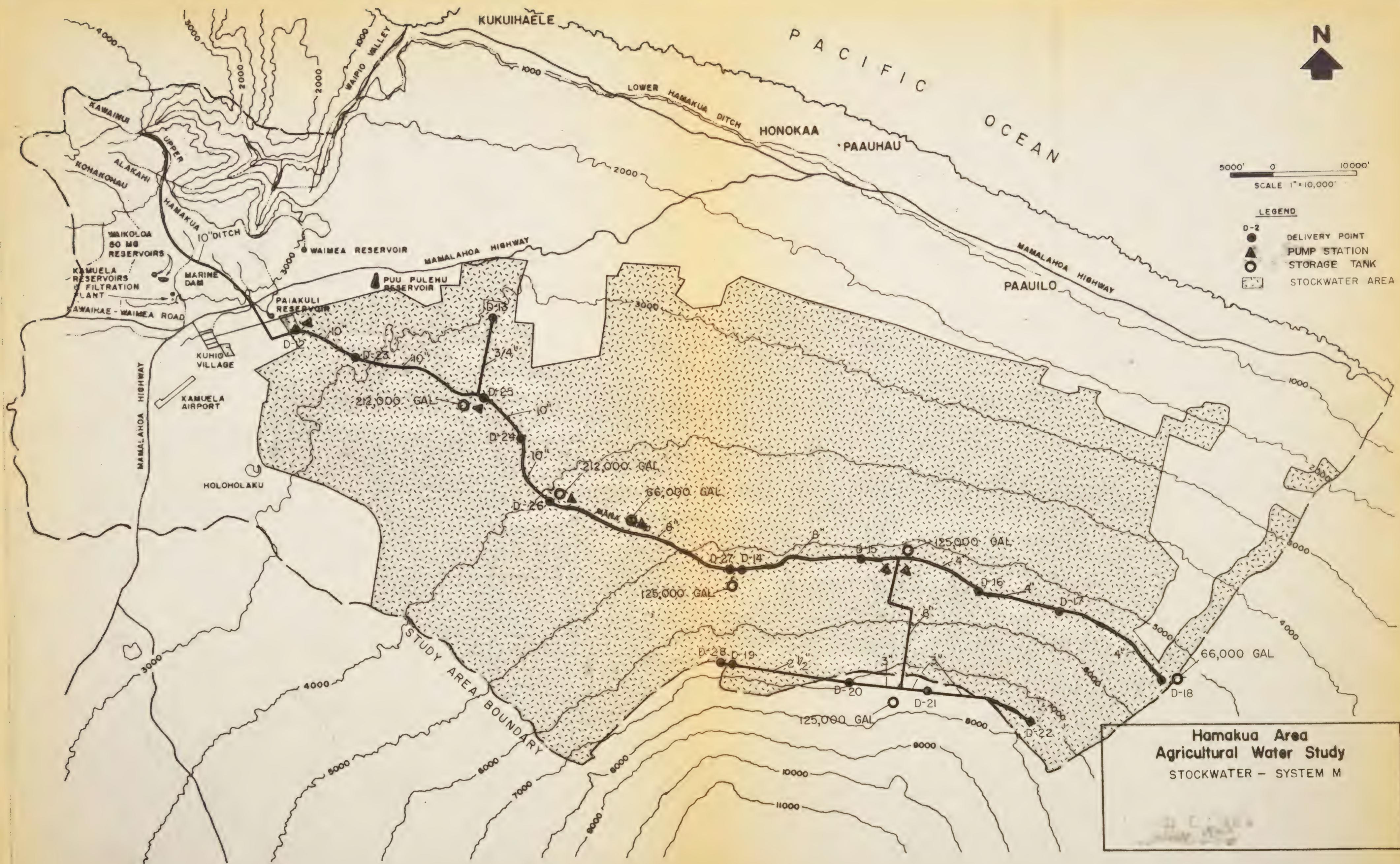
	<u>Total</u>
Board of Water Supply.....	43,900
Parker Ranch.....	37,619
Hawaiian Home Lands.....	9,790
Total	<u>91,309</u>

Installation Cost

	<u>Capital</u>	<u>O&M</u>	<u>Total Annual</u>
Collection System.....	\$ 3,295,500	\$ 77,800	\$ 328,000
Reservoir.....	0	0	0
Distribution System.....	15,409,300	362,500	1,532,200
Total	<u>\$18,704,800</u>	<u>\$440,300</u>	<u>\$1,860,200</u>

Benefits

Benefits.....	\$ 447,200
Benefit-Cost Ratio.....	.24



POSSIBLE ALTERNATIVE

General Description

Irrigation water to supply the existing, presently planned and future expansion of Lalamilo, Hawaiian Homes and Puukapu farmlots. In addition, stockwater to supply the ranches along the Hamakua Coast and in the Kamuela area presently served by the Board of Water Supply.

Collection System

The upper reach of the Upper Hamakua Ditch from Kawainui Stream to Alakahi Stream will be rehabilitated. Water from the Kawainui, Kawaiki and Alakahi Streams will be diverted by an open concrete ditch to the reservoir site. Diversion structures will be designed to bypass low flows and high flows.

Reservoir Storage Requirement

The existing 60-MG reservoir and an additional 460-MG reservoir located in the Kohala Mountains will be needed for storage.

Distribution System

A conduit from the reservoir will be connected to the existing 24-inch conduit servicing the Lalamilo, Puukapu and Hawaiian Homes farmlots. Various size conduit connected to this system will carry water to the farmers along the Hamakua Coast and in the Kamuela area.

Irrigation and Stockwater Requirements

Irrigation requirements were based on sprinkler-irrigated crops and a 80-percent chance annual rainfall; while livestock requirements were based on a 90-percent chance annual rainfall. The peak irrigation and stockwater requirements were used to size the conduits.

Irrigation

Lalamilo.....	<u>7.4</u>	Peak MGD	<u>1,776</u>	Annual MG
Hawaiian Homes and Puukapu	<u>6.4</u>	Peak MGD	<u>1,196</u>	Annual MG
Stockwater.....	<u>.09</u>	Peak MGD	<u>25.6</u>	Annual MG

Area Irrigated or Serviced

		Total
Board of Water Supply (livestock).....		<u>14,790</u>
Lalamilo (irrigation).....		<u>826</u>
Hawaiian Homes and Puukapu (irrigation)		<u>910</u>
Total		<u>16,526</u>

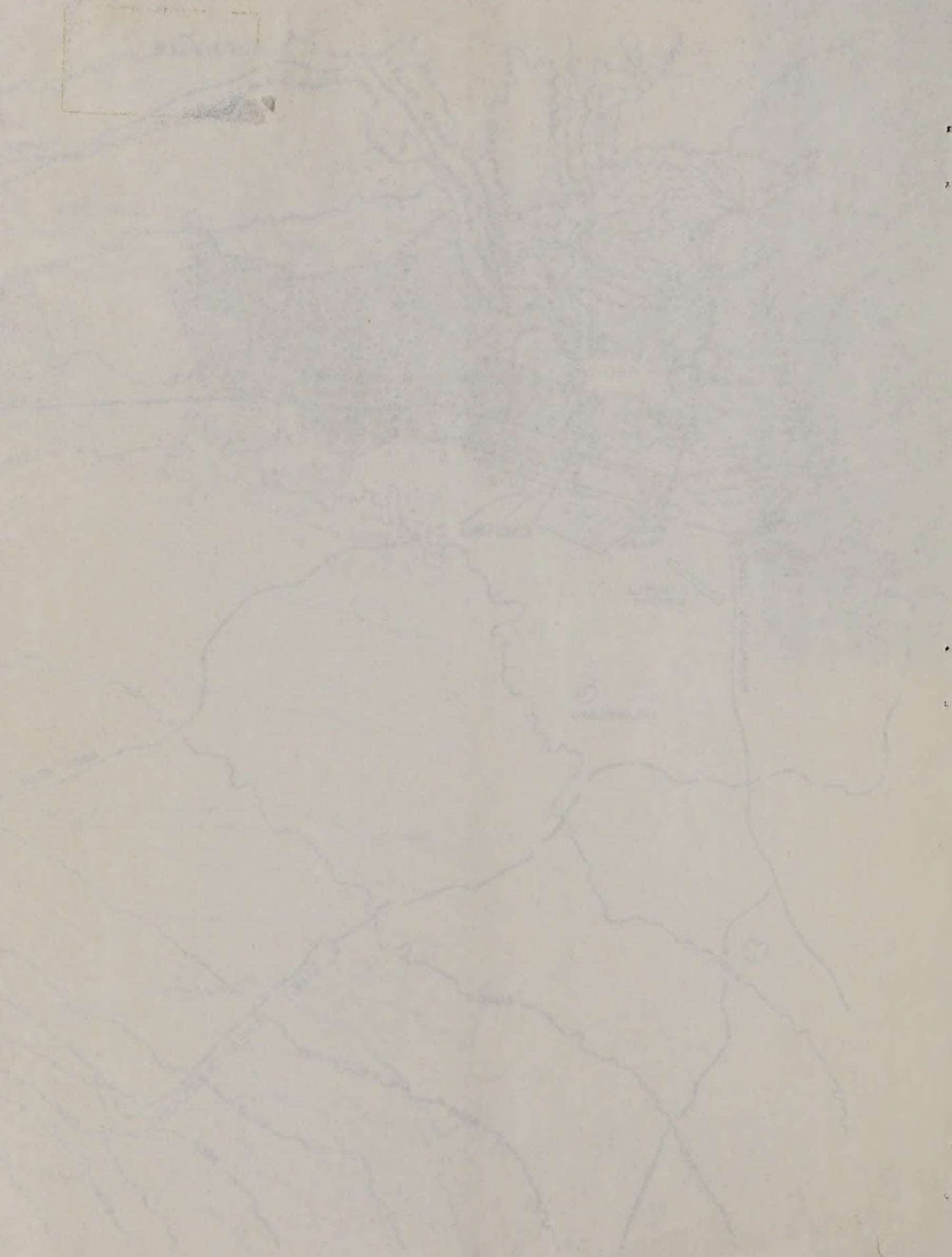
Installation Cost

	Capital	O&M	Total Annual
Collection System.....	\$ <u>7,143,000</u>	\$ <u>29,000</u>	\$ <u>571,200</u>
Reservoir.....	<u>17,200,000</u>	<u>7,500</u>	<u>1,315,200</u>
Distribution System.....	<u>3,605,000</u>	<u>19,700</u>	<u>293,300</u>
Total	\$ <u>27,948,000</u>	\$ <u>56,200</u>	\$ <u>2,177,700</u>

Benefits

Benefits.....	\$ <u>4,282,800</u>
Benefit-Cost Ratio.....	<u>1.97</u>







GLOSSARY

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Acres Irrigated - Number of acres to be irrigated at any one time. Crop may be in various growth stages. Annual and peak irrigation requirements are based on these acreages.

Annual Irrigation Requirements - Irrigation water needs per year were based on crop consumptive use, rainfall, and irrigation efficiencies. The effective rainfall was based on a probability of 80 percent. Drip irrigation with an efficiency of 80 percent was used to determine sugarcane irrigation requirements. Truck crops were sprinkler irrigated with a 60 percent efficiency.

Benefits - The increase in net income due to improvements to the existing agricultural water system. Net income considers the reduced production cost and increased cultivated acreage.

Crop Consumptive Use - The water requirements of the plant. The consumptive use of crops considers the temperature, humidity, wind, solar radiation, and elevation in the farmed area.

Collection System - Open ditches and/or pipelines to collect water from the Upper Hamakua Ditch and convey it to a reservoir or distribution system. Collection system was designed to divert streamflows between the 10 to 90 percent exceedence probabilities.

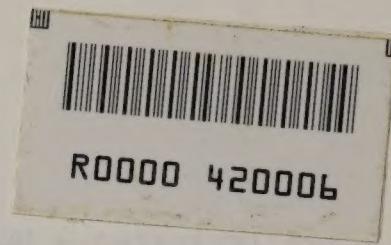
Distribution System - Pipeline to transmit water from the collection system to the pastures, farmlots or sugarcane fields. Pipe diameters were sized to supply the peak irrigation requirements in a 12-hour period.

Peak Irrigation Requirement - The highest demand for water requirements of the crop based on crop consumptive use and irrigation efficiencies. No rainfall was considered.

Reservoir Storage Requirements - Reservoir capacity required to supply irrigation water requirements. Capacities for the following crops were determined:

1. Sugarcane - A water budget program was used taking into account inflow, storage, rainfall, evaporation, seepage losses and outflow.
2. Truck Crops - Capacities were based on supplying 40 days' storage at peak irrigation requirement during a drought period with no inflow.

Stockwater Requirements - The water requirements were based on the needs for an individual animal and the area of pastureland required for each animal. Both of these figures depend on rainfall. The water supplied is for a 90 percent chance annual rainfall.



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